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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/602,266	06/23/2003	Masao Moriguchi	SLA0770	1706

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EXAMINER	
PADGETT, MARIANNE L	
ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/602,266	MORIGUCHI ET AL.	
	Examiner	Art Unit	
	MARIANNE L. PADGETT	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 January 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-21,23,25-44,65 and 66* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-21,23,25-44 and 65* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 1/28/2008 has been entered.

The terminal disclaimer over USPN 6,921,434 to Voutsas has been approved, thus removes the obviousness double patenting rejection set forth in section 7 of the action mailed 11/28/2007.

It is noted that independent claim 1 has been amended to clarify when the direction of lateral growth is rotated with respect to the laser shot steps, thus removing 112, first rejections with respect to previous claim 1 language; and claim 1 has been amended to include limitations of now canceled claim 2, with the additional new requirement that the orientation in the second direction is achieved without rotating the silicon film. The support for the new limitation is found on page 6 cited by applicants, where the examiner further notes that the options of rotating the substrate or rotating the beamlets (beamlets formed by laser beam passing through multiple apertures in a mask) are taught equivalently, with no suggestion of any significant difference in the use or effect of the two options for affecting rotation. The negative limitation of not rotating the Si-film, i.e. the substrate, implies rotating the mask (i.e. the aperture pattern) if the first & second patterns are the same except for orientation, or simply changing the masks to achieve the rotated orientation, all of which are basic procedures known as equivalent means of accomplishing the same results, i.e. rotation of orientation.

2. Claims **25-38 & 65-66** are rejected under 35 U.S.C. **112, second paragraph**, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The preamble of new claim 65 requires laterally growing crystal grains using previously annealed silicon film, hence since in the body of the claim the only annealing takes place in the "using..." limitation

& occurs via directional solidification (DS) in the second area, thus the separately claimed step of "laterally growing crystal grains" (plural), also in the second area, is possibly implied by the preamble to be required to be sequential to the DS annealing, however the body of the claim is not commensurate scope with this interpretation of the preamble, as the language in the body of the claim does not necessitate the claimed "laterally growing..." to occur at any specific time with respect to either the "using..." or "forming..." limitations, only designating which area in which it occurs & requiring no specific techniques to achieve the lateral growth of crystal grains in the second area. Alternately, the preamble could be considered to be requiring the silicon film employed in the process to have been annealed before any of the steps in the body of the claim, however there is no antecedence between the limitations introduced in the preamble & those used in the body of the claim to clarify this issue. Considered in light of the specification, this claim is further unclear, in that the lateral growth discussed in the specification, particularly in the support for these new claims cited by applicants (pages 5 & 8-10, which the examiner notes are illustrated in figures 1 & 6), only discusses the lateral growth being produced **by** the DS annealing, thus contradicting the implications of the preamble, such that the intended meaning of claim 65 may be considered unclear or ambiguous.

The amended language in claims 25, 28, 32 & 35 is unclear or ambiguous, since for example, the representative phrase "annealing the first area **in response to** the first and second energy densities..." (emphasis added) found in claim 25 has multiple possible meanings, as it can mean that the annealing is done at some time after application of these energy densities from the third & first lasers , required due to previous effects of the energy densities of these previously applied lasers. It could also mean that the annealing is caused by the energy applied by these two different lasers, but the amended claim language **as written** does not require any particular way that the annealing is "in response" to the energy densities, nor contrary to applicants' assertion on page 14 of their 1/28/2008 response, does the claim language require "additional limitations that are **performed concurrently** with the previously recited step of ‘using

a 2N-shot laser irradiation process...'" (emphasis added), since the claim as written is silent as to when the method is "further comprising..." the additional limitations. Analogous clarity considerations are applicable to claims 28, 32 & 35.

3. With respect to claim 66, the examiner notes that the "second area" where the "sequentially annealing" is occurring, is defined by "a pair of consecutive grain boundaries oriented in the first direction", hence in the context of the claim's word sequence & with respect to limitations of independent claim 65, "the first direction" is referring to (modifying) the grain boundaries orientation (**not** the direction of annealing), thus is requiring the second area to be confined between two consecutive grain boundaries with no intervening grain boundaries that are oriented in the first direction. Note with respect to DS annealed "quasi-single crystals" 612, 613 & 614 illustrated in figure 6 this would correspond to the pairs of lines 624 & 626, 631 & 630, 630 & 633, respectively, illustrating grain boundaries in one direction in the grid, noting that second direction pairs of grain boundaries of these illustrated crystals are only consecutive for the crystal 612.

4. Claims **65-66** are rejected under 35 U.S.C. **112, first paragraph**, because the specification, while being enabling for **a crystallization procedure applied to amorphous silicon (a-Si) for making polycrystalline silicon that first employs the "2N-shot laser irradiation" techniques, as set forth in the specification, to produce claimed grain boundary configurations, then employs directional solidification that may laterally anneal an area defined by two pairs of grain boundaries**, does not reasonably provide enablement for forming a polycrystalline structure from a silicon film having unlimited or unspecified microstructure, via techniques that need employ neither a laser nor the specific 2N-shot laser irradiation techniques to create a parallel grain boundary configuration, and may create the claimed plural laterally grown crystal grains in the second area via techniques other than the DS annealing process. The specification does not enable any person skilled in

the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Claims **65-66** are rejected under 35 U.S.C. **112, first paragraph**, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The new claims as presented & in view of cited support, appear to encompass **New Matter**, as they are broader than the scope of the enabling disclosure, as well as ambiguously include claiming lateral solidification to form crystal grain**s** during a step other than, possibly after, DS annealing in the same (second) area. Specifically note that the original method claims 1-48, with only claim 1 being independent, all required 2N-shot laser irradiation process applied to amorphous silicon to form the polycrystalline structure, with dependent claim 3 indicating this 2N-shot laser irradiation process was producing grain boundaries structures as encompassed by new independent claim 65, thus the original claims do not provide support for the broader scope of new claim 65-66 that do not require use of laser in the microstructure formation. It is further noted that the Field of the Invention specifically specifies that the process is "for laser irradiating silicon films to produce polycrystalline silicon, in selected areas, free of grain boundaries", which while a contradictory statement as phrased (anything that's polycrystalline must-have grain boundaries or it can't have plural crystals), clearly indicates the requirement of using a laser in forming the polycrystalline structure.

Applicants' citation of support on page 22 of the 1/28/2008 response for new claims 65-66, indicates support on **page 5, lines 1-14** of the specification, which is discussing the **DS annealing** growth process of polycrystalline grains as illustrated in figure 1 & specifically requires employing "laser beamlets width" (line 4) in producing the illustrated structures, indicating that at each step the grains grows laterally from crystal seeds of polycrystalline material formed in the previous step, hence only

supports the **DS annealing producing the laterally** growing crystal grains, but does not support lateral growth at a separate step from the DS annealing, & this section does not discuss preceding substrate structure, hence is not germane to or does not relate the DS annealed lateral growth to substrate structure (i.e. grain boundaries) before the start of the DS process.

Applicants have further cited **page 8, lines 1-page 10, line 26** as support. The examiner notes that these three pages discuss figure 6, which is directed to an "a-Si film", which has been treated by the "2N-shot process", which requires laser irradiation, as described in preceding sections (page 2, lines 20-22; page 3, lines 1-2 (on amorphous silicon); page 6, lines 10-27+ describing figure 4 & treating a-Si), with page 3, lines 3-13 relating to grain boundaries (GB) formed by the 2N-shot laser irradiation, followed by employing the DS process to anneal & smooth/remove the grain boundaries. Page 8 has extensive discussion of grain boundaries formed by the 2N-shot laser irradiation process on a-Si film 60, illustrated in figure 6, & having grain boundary structure as claimed. The paragraph bridging pages 8-9 discusses "quasi-single crystals" with respect to the illustrated grain boundary grid, with various location options discussed, and the last two sentences of this paragraph supporting using DS annealing with respect to the GB grid & the last sentence suggesting lateral growth, although using different semantics. The next two paragraphs discuss various DS annealed crystal structures with respect to grain boundaries, particularly a pair of two grain boundaries, which may or may not be consecutive, etc., but at no point does the disclosure suggest using any other techniques with or after the directional solidification annealing in order to produce the lateral growth of crystal grains in the second area defined by the two pairs of grain boundaries, nor suggest forming the GB grid without the 2N-shot laser irradiation process, or on a silicon film other than amorphous silicon.

For these reasons, these new claims as presented appear to encompass **New Matter**, as their scope is broader than suggested or enabled by the original specification.

5. It is noted that in the paragraph bridging pages 21-22 starts by stating "Fig. 14 is a flowchart illustrating...", which is okay by itself, as the referenced figure shows a series of steps with arrows in between each step, thus explicitly indicating that each step in the box follows the one before, which is consistent with the classic meaning of "flowchart" & inherent in the drawing of the arrows. However, this paragraph then goes on to say "Although the method in Fig. 14 is depicted as a sequence of numbered steps for clarity, no order should be inferred from the numbers unless explicitly stated". The examiner notes that the **arrows** in the figure are considered an **explicit statement of order**, especially when it is explicitly called a flowchart. The further statement that "it should be understood that some of these steps may be skipped, performed in parallel, or performed without requirement of maintaining a strict order of sequence" is considered to contradict the meaning of "flowchart", the arrows, etc., and essentially say that figure 14 is a meaningless jumble of steps with unclear relationships to each other, unclear effects with respect to each other & no particular significance respect each other, thus figure 14 **cannot** be said to really **enable** any process with any surety or clarity, as essentially any combination of steps are said to be represented by figure 14, it cannot be considered to have or enable any particular results. For example, in light of clearer sections of the specification, it appears that step "1410" could be considered to be providing a description of "step " 1404, such that figure 14 would appear to be requiring two different applications of iterative laser processes not clearly distinguishable, therefore this figure is really a confusing mess designed to confuse anyone who looks at it, so as to only provide confusion about what the inventive process really involves. As a consequence of the contradictory language with respect to the figure, none of the boxed/numbered steps of figure 14 can be considered to be provided any meaningful context or relationship with respect to any of the other steps.

Due to the confusion generated by figure 14 & its contradictory aspects & description, only those relationships with respect to figure 14 that are clearly set forth & the expected effects reasonably

described or suggested, will be considered to provide adequate enablement for the suggested but not actually detailed, unlimited possible combinations.

The **disclosure is objected** to because of the following informalities: for reasons as discussed above, figure 14 causes confusion with respect to taught process steps sequence, such that clarification is needed. Appropriate correction is required.

6. Claims **25-38** are rejected under 35 U.S.C. **112, first paragraph**, as failing to comply with the enablement requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

While it might be considered ambiguous as to whether these claims encompass any new matter due to their ambiguous amended language, since the contradictory description of the "flowchart" of figure 14 essentially suggests combining any of the limitations listed therein any-which-way, it could be considered that no such combination is new matter, however that does not mean that all such combinations are properly **enabled**.

With respect claim 25, applicants cite page 23, lines 8-19, which explains step 1407, however this description does not provide enablement for all possibilities of the amended claim (see section 2 above), nor is the discussion on page 23 which explicitly states that the annealing is after exposing to an additional energy source, enabling for the breath of the claimed limitations; nor does this discussion in the specification enable when the additional energy source (possibly third laser beam) is applied with respect to the first laser; or explain how one uses both energy densities from sources applied at unspecified times with respect to each other, so that annealing occurs at a later time as indicated by "Then" on page 23. For these reasons, enablement of the further limitations of amended claim 25 & its dependence is insufficient & unclear. Note it is also unknown how these additional steps of projecting a third laser beam & annealing would affect the previously required formation of polycrystalline silicon with the specific grain

boundary configuration of claim 3, from which claim 25 depends, especially considering the discussion on page 23 of the specification sheds no light on this topic (i.e. the annealing may be performed to wipe out the presence of all grain boundaries or the like). Also, the **claim language** does **not** provide any clear relationship or timing with respect to the DS annealing that is also a claimed requirement, so no necessary or clear results can be determined as resulting from these additional limitations. The lack of clear enablement & clarity in the claims, means that they cannot even be read in light of the specification to determine what effect is probably intended.

With respect to claim 28, page 23, lines 20-page 24, line 3 cited as support by applicants, only teach exposing the first area to excimer laser light at some time in its existence, with no enablement for any particular effect or timing.

Claims 32 & 35, depend through claim 11, which further limits the DS process using a second laser beam, however again there's no clear relationship in the claims **as written** to **when** the further laser or lamp, respectively, is applied with respect to the laser used for the DS process, nor any clear relationship between "annealing in response to" & the independent claim's DS caused annealing. Applicants cite page 25, lines 9-22 & step 1422, which only discusses using a laser for sequential annealing & does not related to the rest of the claimed process. Furthermore figure 14, as pointed out above & by applicants own disclaimer in the specification concerning figure 14, cannot be said to provide specific enablement for any particular affects of any particular combination from its unlimited combinations. Applicants have additionally cited page 26, lines 1-23 & step 1419, however this teaching which states "... exposes the second area to an additional energy source. Then, annealing..." has the same or analogous deficiencies as pointed out above with respect to the citation beginning on page 23, line 8.

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

> having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 1, 3-21, 23, 25-44 & 65-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sposili et al. ((6,908,835 B2) or WO 02/086954 A1), and further in view of Yamazaki et al. (5,894,137), plus Fukunaga et al. (2004/0142543 A1) or Kawasaki et al. (6,653,657 B2) as discussed in sections 21-22 & 25 of the action mailed 9/19/2006.

Applicants have amended their claims to put a negative limitation in the independent claim that essentially requires that the second aperture pattern be applied to the substrate via any technique, except rotating of the substrate. While the particularly relevant stage of the example of Sposili et al. (835) discussed on col. 24 & illustrated in figure is 13A-D & 14, rotates the substrate 90° in order to perform the equivalent of applicants N = 2 or second set of shots, it would've been obvious to one of ordinary skill in the art that the equivalent effect would have been expected to be equally effectively created by rotating the pattern mask used to create the crystallized col.s with their grain boundaries, configured as claimed, especially considering that Sposili et al. (835) specifically teach that the motions for their SLS processing can be performed by controlling the translation or motions of the substrate (sample 40), or alternately by using the computer to control the motions of the mask and/or the laser (col. 6, lines 19-col. 7, line 17, especially col. 6, line 40-42, col. 7, line 1-10 & 12-15), where they specifically note that the <u>exemplary</u> embodiment controls motioned by translation of the sample, but then explicitly teach the expectation that

these other techniques, inclusive of controlling movements of the mask, would have been expected to be equally effective. Sposili et al. (835), also incorporate by reference SN 09/526,585= PN 6,368,945 (IM: col. 4, especially lines 8, 11-18, 25-35, 40-45 & 54-56, etc.), which describes an apparatus usable in Sposili et al. (835), and has further teachings concerning the alternative equivalent use of translation of either the sample stage or the mask stage. Furthermore, in col. 22, especially lines 23-37 & 54-63, Sposili et al. (835) at a specific stage of their example, where the mask is rotated 180° in order to move the grayscale portion (see illustrated in masks of figures 11 or 12) over previously irradiated & re-solidified areas, so as to radiate at reduced intensity (≡ possible meanings encompassed by amended claim 25) areas already subject to first & second beamlets (≡ two shots of the laser beam through the patterned apertures), where this additional irradiation is taught to maintain the integrity of the grains grown by the preceding beamlets irradiation. This procedure explicitly shows that the apparatus employed is capable of the alternatively taught means of changing the exposure via movement of the mask assembly versus movement of the substrate. For these reasons, the addition of claim 2 & the negative limitation excluding rotation of the silicon film, hence rotation of substrate, are not considered to provide patentable significance to the claimed process. See analogous teachings & discussion in Sposili et al. (WO).

The examiner additionally notes that with respect to amend the claim 28, which is equivalent to amended claim 25, except employs a lamp for possibly the same purpose as a laser, that as it is old and well-known in the art of radiation treating substrates, including annealing, that either light or lamp sources may be equivalently employed, depending on the particular lamp & the parameters by which they are adjusted, with it further noted that since Sposili et al. (835) is specifically teaching that these additionally added light radiation is at a reduced intensity, that employing a lamp would have been an obvious alternative, since unless the light from a lamp is

focused, it is generally at a lesser intensity than light from a laser, thus using a lamp would have affected a similar results as using the grayscale portion in the mask, as exemplified on column 22 of Sposili et al. (835).

Also, in column 24, when discussing the final stages of creating the resultant substrate illustrated in figure 14 with the square single grains created between illustrated consecutive pairs of orthogonally related grain boundaries, Sposili et al. when discussing the final stage of the process with respect to figure 13D online is 44-49 note that lateral grain growth is seeded and promoted from the borders using the grains grown using the process described in reference to figures 5A-G, thus it would've been further obvious to one of ordinary skill in the art, that the step described on column 22, lines 23-67, which applies additional radiation & also refers to figures 5A-D, would also have been expected to be effectively applied at this point in order to accomplish or aid the taught lateral grain growth, which is a species of directional solidification & may be considered to read on &/or be consistent with the claimed directional solidification process to anneal a second area, where each individual crystal grain between grain boundaries may be considered a second area, or alternately, can be considered related to any of claims 25, 28, 32 or 35, & their dependents, for reasons as discussed above.

In the reference (PN 6,908,835 B2 or WO 02/086954 A1) to Sposili et al., the applicants were previously particularly directed to the abstract; and figures 13 (especially 13A) & 14, discussed on col. 5, lines 66-col. 6, line 11 & col. 24, where col. 24, lines 5-18 & 55-58 (in (835) with equivalent teachings in the parent PCT document) are particularly noted. As discussed in the abstract, Sposili et al. ((835) or WO)'s basic process employs two shots while using masks that define a plurality of beamlets for irradiating portions in the two successive shots to thus treat a contiguous area. A particular embodiment discussed with respect to figures 13 & 14, employs the basic process as discussed in the abstract to create

SLS crystallization, then rotates the substrate 90° on the translation stage & performs the two shot process again, hence reading on applicants' 2N-shot laser irradiation process as now claimed. Note the figure 14 in Sposili et al. ((835) or WO), would appear to illustrate creation of single grains, inclusive of alternating crystal orientations, thus apparently inclusive of the direction of lateral growth being rotated 90° from the previous two shot step. As noted in col. 1, lines 5-14+, the techniques taught in Sposili et al. ((835) or WO) are intended to form large grain microstructure from amorphous semiconductor materials, where the grain-boundary-location is controlled, which are desirable to use in fabricating higher-quality devices, inclusive of transistor arrays (col. 1, lines 50-54). Sposili et al. ((835) or WO) is directed to this large grain crystallization process for the amorphous silicon/semiconductor films, and does not contain teachings directed towards particular parameters or significance subsequent processing to be employed in the creation of particular semiconductor device structures. However, the references of Yamazaki et al. (5,894,137), in view of Fukunaga et al. (2004/0142543 A1) or Kawasaki et al. (6,653,657 B2), which discuss relevant processing of crystallized amorphous material, particularly with respect to grain structures & device formation, would have provided obvious subsequent processing techniques applicable to the initially recrystallize material for reasons as discussed in previous actions .

To reiterate previous discussion, Fukunaga et al (abstract; [0030]; [0087-89]; [0111]; [0128-130]; [0144]; [0156]; & claims), teach use of lasers, such as KrF excimer lasers, to crystallize amorphous silicon that has had a catalytic element, such as nickel deposit thereon, especially given further analogous teachings of performing further annealing treatments on the crystallized area to improve the crystallinity thereof, along with teachings of lateral growth ([0052-57]; [0059-67]; [0092]; [0114]; & [0131-133]), such that one of ordinary skill would have expected the taught laser crystallization using a catalytic element of Fukunaga et al. to have been effective for the crystallization step of Sposili et al. ((835) or WO), hence in would have been obvious to one of ordinary skill in the art to employ in this

claimed process any energy source known to be effective for metal catalyzed crystallization of amorphous silicon to produce a polycrystalline silicon.

It was noted that the SLS process combines both the claimed laser irradiation and directional solidification annealing processes, where the areas may be the same, or the arbitrary designations of the claim may correspond to areas treated as described in Sposili et al. ((835) or WO). With respect to the aperture usage in claim 2, note that the 90° rotation will affect the claimed orientation for the second step, especially considering that the second aperture need not necessarily be different than the first aperture.

With respect to the parallel grain boundaries of claim 3 & the claims dependent therefrom, the SLS technique inherently creates grain boundaries at its edges, which as it scans or steps would create a plurality of essentially parallel grain boundaries on opposite sides of the crystallize grain, which for a controlled beam spot & controlled parameters would inherently be equally spaced. The choice of the width would depend on desired enduse combined with parameter control of the laser beam, and as such would have been expected to include widths as claimed, since they are typical dimensions desired for electronic features in semiconductor devices like TFT's, such as are to be formed with the crystallize products of this reference. That Sposili et al. may use plural patterns in processing of the substrate would indicate that there may be different sets of such crystallized silicon film, with different or the same width, depending on the design requirements for the particular circuitry being created. Alternately, for mass patterns that are square or worked rectangular as shown in the mask 8 of figure 5, each pulse would give two sets of orthogonal parallel grain boundaries, where patterns with multiple apertures, exemplified by the set of 4 rectangles would provide a plurality of such parallel grain boundaries, where squares would have first and second widths equal, while rectangles widths are unequal.

It remains further noted that the sequential lateral solidification employed by Sposili et al. (((835) or WO), which for this purpose is analogous to the previously applied (380)) effectively removes or pushes to the end one side of the grain boundaries and ridges associated therewith, while extending the

length of the grain boundaries in the direction of stepping our motion, which would appear to be the types of actions being referred to in claims 12, 13 and like. Note that the transistor arrays discussed by Sposili et al. ((835) or WO) as desirable and uses are old and well-known to require doping, typically via ion in plantation, which requires subsequent annealing, thus it would've been obvious toward of ordinary skill in the art to employ typical processing techniques for creating such devices in conjunction with the specific crystallization procedure of Sposili et al. ((835) or WO).

Alternately to Fukunaga et al., Kawasaki et al. (657) teaches crystallization of amorphous silicon to form polycrystalline with lateral growth, where the crystallization procedure may use heat or laser (single or dual lasers, excimer with single or plural pulses), and may be performed with or without a catalytic element (abstract; col. 1, line 28-col. 2, line 6; col. 3, lines 14-32 & 56-68+; col. 6, line 20-col. 7, lines 68+), hence providing a further showing of the obviousness of using laser crystallization as the energy source for the initial crystallization process of these claims.

As previously noted the claims has written include first area = second area or significantly overlap there with, where Fukunaga et al. may have a further radiation treatment to enhance the crystallization that may use a strong light such as an infrared lamp or may use a second laser irradiation procedure, where this annealing step after the initial crystallization step is also said to proceed or is on to lead in its crystal growth ([0099], [0114] & [0131-132]), which would read on the alternative option of the laser irradiation process being different from the directional solidification annealing process, but where first area still equals second area.

Yamasaki et al. (137) teach a crystallization process of amorphous silicon, which has been coated with a silicon oxide film having an aperture that exposes region 405 on to which a catalytic element, such as nickel is introduced, and thereafter heating is performed to cause crystallization, where lateral growth occurs, however grain boundaries that occur between adjacent crystals that are perpendicular to the direction of crystal flow in the base region, i.e. channel result in potential barriers and hinder the flow of

current. Therefore to improve the crystallization in these areas and create "monodomain regions" that are substantially single crystal with no grain boundaries in the crystalline silicon, it is further taught to improve the crystallization via application of laser beam such as excimer lasers (KrF at 248 nm or XeCl at 308 nm) or rapid thermal annealing using strong light from IR or UV lamps. This annealing of the lateral growth region is locally heating high temperatures such that the metal silicide from the catalytic element is precedently melted, eliminating grain boundaries, In re solidifying to form essentially a single crystal domain in such a way that can be considered to remain lateral or directional. See the abstract; figures; col. 4, line 5-col. 5, line 14 (influence of grain boundaries in TFT); col. 6, lines 39-55; col. 7-8, especially col. 7, lines 10-15, 35-44 & col. a, lines 20-35; col. 9, lines 41-65; col. 11-line 6-55; col. 12, lines 5-42; col. 13, lines 1-60 & 66-col. 14, line 5.

Yamasaki et al. (137) differs from the present claim by initially turning the amorphous crystal into polycrystalline via a thermal process, however as has been seen above with respect to Fukunaga et al. or Kawasaki et al. (sections 15 or 21) it was known to provide equivalent lateral growth crystallization processes using catalytic elements employing either her thermal or laser processes, hence as discussed above it would've been obvious to one of ordinary skill in the art to employ the alternate technique of laser treatment, instead of the purely thermal treatment to induce the crystallization formation.

It is noted that Yamazaki uses apertures in his process, and it would've been obvious to one of ordinary skill to use multiple apertures in a process to produce multiple polycrystalline regions forming multiple TFT structures, since designs for circuitry require multiples of such functional structures.

While Sposili et al. does not specifically discuss using in selecting a third aperture patterns on a second top area it relates to a portion of the second area etc., as noted above they do suggest using their process not just for the initial crystallization, but also for successive annealing processes, which as can be seen in the above discussed processes of Yamasaki et al. (137), Fukunaga et al. or Kawasaki et al., that the crystallization of amorphous silicon & formation devices such as TFT constructions, Main compass

multiple annealing steps, that may employ multiple laser usages, or may employ strong light from lamps in a similar fashion, where the area that was initially crystallized, is again partially or wholly annealed again, possibly both before implanting for TFT formation, and thereafter. Therefore given Sposili et al.'s suggestion for advantageous end uses, it would have been obvious to one of ordinary skill in the art to employ such sequential annealing processes as taught in Sposili et al. for any of the laser annealing techniques as presented in the above combination of Yamazaki et al. plus Fukunaga et al. or Kawasaki et al., further noting that the previously discussed embodiments exemplified in these references, where they are forming TFT devices further teach laser annealing after doping, consistent with Sposili et al.'s suggestion of further usage.

With respect to the various claimed combinations of parameters, such as energy density, wavelength, etc., previously noted lamps and lasers employed in the secondary and tertiary references supply various claimed wavelength and pulse duration, etc., parameters for use in their process, as well as all references recognizing the importance of energy or light intensity or energy density impinged on the surface being treated, in order to control the effects of that light in the various crystallization, recrystallization & annealing processes, hence it would've been obvious to one of ordinary skill in the art to employ such teachings in optimizing the success of sequential processes as suggested by this combination, in order to produce desired and reproducible results.

9. Applicant's arguments filed 1/28/2008 & discussed above have been fully considered but they are not persuasive.

10. Other references of interest of the state of the amorphous silicon crystallization art include: Park et al. (2007/0272928 A1), Jung (2008/0064152 A1 & 7,312,471 B2) & Im et al. (2008/0035863 A1), however none of these references are prior art.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marianne L. Padgett whose telephone number is (571) 272-1425. The examiner can normally be reached on M-F from about 8:30 a.m. to 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

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/Marianne L. Padgett/
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